

ARNOLD ENGINEERING DEVELOPMENT CENTER

J2 TEST FACILITY

ARNOLD AFB, TN

PIPING & EQUIPMENT INSULATION
PACKAGE

WORK PACKAGE 6150-10

ISSUED
FEB 6, 2004

I. GENERAL

A. The following sketches are included as part of this specification:

SK631760.11	INSULATION REQUIREMENTS, COMPRESSOR OUT-BLEED
SK631760.13	INSULATION REQUIREMENTS, 1-PAC SUPPLY & RETURN
SK631760.15	INSULATION REQUIREMENTS, 3-PAC SUPPLY & RETURN
SK631760.17	INSULATION REQUIREMENTS, COMPRESSOR IN-BLEED
SK631760.20	INSULATION REQUIREMENTS, DISTORTION & 3-PAC AIR SUPPLY
SK631760.21	INSULATION REQUIREMENTS, 10" AIR SUPPLY TO TEST CELL
SK631760.25	INSULATION REQUIREMENTS, 4" AIR SUPPLY TO TEST CELL

B. Provide all labor, materials, equipment, and transportation required to install insulation on piping and various equipment as given below and on the contract sketches. Contractor shall properly dispose of any waste per AEDC and State procedures.

1. EXTERNAL TO THE J2 TEST CELL

- a. 12", 10" and 8" piping from the T3 Heaters to the piping anchor located at the interface to the J2 Test Cell. (Ref: Sketch SK631760.21).
- b. 8" and 6" piping from the 10" hot air supply line to the Vent Silencer located on top of the Fuel Barricade Building (Ref: Sketch SK631760.21).
- c. Piping from the 10" hot air supply line to the hot mixing valve HPA-TCV1-RK located on top of the Fuel Barricade Building (Ref: Sketch SK631760.25).
- d. Piping from the discharge of the Mixing Valve Station located on top of the Fuel Barricade Building to the piping anchor located at the interface to the J2 Test Cell (Ref: Sketch SK631760.25).
- e. 3" and 2" piping associated with the hot mixing valve HPA-TCV1-RK in the temperature mixing station located on top of the Fuel Barricade Building (Ref: Sketch SK631760.25).
- f. Two spectacle/flange assemblies, HPA-SB3-RK and HPA-SB4-RK, located in the 12" piping in the area of the T3 Heaters (Ref: Sketch SK631760.21).
- g. Hot Air Valves:
 - HPA-FV15-RK 6" 900# globe valve (Ref: Sketch SK631760.21).
 - HPA-AV5-RK 10" 900# butterfly valve (Ref: Sketch SK631760.21).
 - HPA-AV6-RK 10" 900# butterfly valve (Ref: Sketch SK631760.21).
 - HPA-TCV1-RK 2" 900# globe valve (Ref: Sketch SK631760.25).
 - HPA-RV16-RK **Do Not Insulate**, 4" X 6" relief valve (Ref: Sketch SK631760.25).
- h. Expansion Joints:
 - Five (5) hinged expansion joints in the 10" hot air supply line (Ref: Sketch SK631760.21).
 - Four (4) gimbal expansion joints in the 10" hot air supply line (Ref: Sketch SK631760.21).

2. INTERNAL TO THE J2 TEST CELL

- a. 3" and 4" compressor out-bleed piping (Ref: Sketch SK631760.11). Out-bleed piping has 2" thick insulation.
 - b. 2-1/2" and 3" 1-PAC supply and exhaust piping (Ref: SK631760.13). Supply piping has 2" thick insulation and exhaust piping has 1" thick insulation.
 - c. 3" 3-PAC supply and exhaust piping (Ref: Sketch SK631760.15). Supply piping has 2" thick insulation and exhaust piping has 1" thick insulation.
 - d. 8" compressor inbleed piping located inside the J2 Test Cell (Ref: Sketch SK631760.17).
 - e. 3" and 4" distortion air supply and 3-PAC air supply piping (Ref: Sk631760.20).
 - f. Hot Air Valves:
 - HPA-PCV15-RK **Do Not Insulate** – 3" pressure regulator, flight hardware. (Ref: Sketch SK631760.11).
 - HPA-FCV3-RK 4" 900# butterfly valve (Ref: Sketch SK631760.11).
 - HPA-AV9-RK 3" 600# butterfly valve (Ref: Sketch SK631760.13).
 - HPA-FCV4-RK 3" 300# butterfly valve (Ref: Sketch SK631760.13).
 - HPA-FCV1-RK 10" 900# globe valve (Ref: Sketch SK631760.15).
 - HPA-AV8-RK 3" 300# butterfly valve (Ref: Sketch SK631760.20).
 - HPA-PCV18-RK 3" 300# butterfly valve (Ref: Sketch SK631760.20).
 - HPA-AV7-RK 4" 300# butterfly valve (Ref: Sketch SK631760.20).
 - HPA-QV1-RK 4" 900# globe valve (Ref: Sketch SK631760.20)
 - HPA-FCV15-RK 6" 900# globe valve (Ref: Sketch SK631760.25)
 - g. Flexible Metal Hoses – numerous - **Do No Insulate** any flexible portion of a flexible hose
- C. Service: High pressure air. Temperature ranges from ambient to 1100 deg F.
- D. The insulation material must be kept clean and dry prior to installation.
- E. Dust and scrap insulation created will be confined to the immediate area. Debris is to be cleaned from the area on a daily basis.
- F. Insulation installation shall be accomplished to keep the insulation material clean and dry until it is completely sealed. Any unsealed insulation shall be protected by temporary measures if precipitation from weather conditions is imminent.
- G. The contractor shall be responsible for the safety of his structures, equipment and personnel during the work under this contract. The contractor shall conform to the following AEDC Safety Standards:
- 1. A6 User and Subcontractor Safety, 26 Sep 2002
 - 2. B1 Master Work Permit, Oct 2003

Work clearances: Access to the system must be coordinated with Testing and Facility Operations. A work clearance must be obtained from the area supervisor prior to start of work.

3. D3 Identification of Piping Systems, 30 Sep 2002
- H. The Government will allow the contractor use of the 100 psig shop air, 120/208 volt (60Hz) and 480 volt, 3 phase power outlet, potable water and any available permanent lighting.
- I. High noise levels from adjacent plant equipment may be present during the course of the contract which requires the use of ear protection.

II. PRODUCTS

A. Insulation – 2 layer system:

1. Inner layer: Alumina-silica ceramic fiber, high purity, 2400 deg F temperature limit, 6 pounds per cubic foot density. Manville Cerawool, AP Green Inswool or equal.(BRAND NAME OR EQUAL)
2. Outer layer: glass fibers bonded with a thermosetting resin suitable for use at temperatures up to 850°F.
3. Provide calculations showing that the interface between the inner and outer insulation systems is < 700°F based on an ambient temperature of 95°F, a 5 mph wind blowing over the pipe, and a 0.8 emissivity value for the aluminum jacket.

B. Jacketing:

1. Aluminum jacket:
 - Outside test cell - 0.029 inch nominal thickness sheet. Jacket to be metal only without a vapor barrier.
 - Inside test cell - 0.040 inch nominal thickness sheet. Jacket to be metal only without a vapor barrier.
2. Bands on aluminum jacket: 1/2 inch by 0.020 inch stainless steel.
3. Joint sealer: Provide weather tight sealant. Service temperature -50°F to +140°F.

III EXECUTION – PIPING EXTERNAL TO TEST CELL

A. The following lines will be insulated per the requirements given below:

1. 12", 10", and 8" hot piping from the T3 Heater to the pipe anchor located at the piping interface with the J2 test Cell.
2. 8" and 6" hot piping from the 10" main hot air supply line to the vent silencer located on top of the Fuel Barricade Building.
3. 3" hot piping from the 10" main hot air supply line to the hot air mixing valve (HPA-TCV1-RK) located on top of the Fuel Barricade Building.

Insulation Requirements

- a. Install 2 layers (one each of ceramic-fiber and fiber glass) on piping and piping components. Total insulation thickness will be 5-inches. Stagger joints between inner and outer layers of insulation. Per section II.B.3 of this specification, the interface temperature shall be $< 700^{\circ}\text{F}$.
 - b. Use stainless steel wire to tie-down each layer.
 - c. Install aluminum jacket (without paper backing) over all insulation. Lap aluminum jacket a minimum of 2-inches over the pre-insulated pipe supports.
 - d. Install slip joints on the jacket to compensate for thermal expansion of the pipe. Expansion will be 1.4-inches in length for every 10 feet of pipe
 - e. Install jacket in a water shedding position with a minimum 3 inch overlap on circumferential joints.
 - f. Overlap all longitudinal joints a minimum of 2 inches and apply joint sealer to each face. Longitudinal joints will be positioned on the bottom of horizontal pipe.
 - g. Apply joint sealer around all openings and cutouts and around all instrumentation protrusions through the jacket.
 - h. Install flashing at the piping/building interface. Flashing shall thermal movement of the piping, $\pm 2''$ axially and $\pm 1\text{-}1/2''$ in any direction normal to the axis of the pipe.. Apply sealant to assure no leakage.
 - i. Hot valves, flange pairs, and expansion joints:
 - Install removable insulation covers on all hot valves and flanges. Covers to be fabricated with 4 inches of ceramic fiber insulation with a stainless steel mesh inner liner and a silicon cloth exterior. Removable covers to be weather resistant and custom fitted to the location. Overlap on both sides to assure a tight fit-up. Fabricate covers to allow easy removal and reinstallation without damage to the cover. Position lacing on the bottom to help keep out water.
 - Provide weather resistant silicon cloth to be installed over the removable pads so that they extend past the pads and 6-inches onto smooth pipe. Tightly secure the cover to smooth pipe with reusable banding. The purpose of this outer cloth is to add an extra layer of protection from accidental hydraulic oil spray from nearby equipment. In case of an oil spray, this outer cloth could be removed, cleaned and then reinstalled.
 - On expansion joints, install insulation cover on the bellows only. **Do Not Insulate** the hinge pins. The end connections (butt-weld joint) shall be insulated to the same requirements as the joining pipe.
4. 4" and 3" hot piping from the hot/cold mixing station located on the Fuel Barricade Building to the pipe anchor located at the piping interface with the J2 test Cell.
- a. Install 2 layers (inner layer of ceramic-fiber, outer layer of fiber glass) on piping and piping components. Total insulation thickness will be 4-inches. Stagger joints between inner and outer layers of insulation. Per section II.B.3 of this specification, the interface temperature shall be $< 700^{\circ}\text{F}$.
 - b. Use stainless steel wire to tie-down each layer.
 - c. Install aluminum jacket (without paper backing) over all insulation. Lap aluminum jacket a minimum of 2-inches over the pre-insulated pipe supports.

- d. Install slip joints on the jacket to compensate for thermal expansion of the pipe. Expansion will be 1.4 inches in length for every 10 feet of pipe. Slip joints shall be weather proof.
- e. Install jacket in a water shedding position with a minimum 3 inch overlap on circumferential joints.
- f. Overlap all longitudinal joints a minimum of 2 inches and apply joint sealer to each face. Longitudinal joints will be positioned on the bottom of horizontal pipe.
- g. Apply joint sealer around all openings and cutouts and around all instrumentation protrusions through the jacket.
- h. Flange pairs:
 - Install removable insulation covers on all hot flanges. Covers to be fabricated with 4-inches of ceramic-fiber insulation with a stainless steel mesh inner liner and a silicon cloth exterior. Removable covers to be weather resistant and custom fitted to the location. Overlap on both sides to assure a tight fit-up. Fabricate covers to allow easy removal and reinstallation without damage to the cover. Position lacing on the bottom to help keep out water.
 - Provide weather resistant silicon cloth to be installed over the removable pads so that they extend past the pads and 6-inches onto smooth pipe. Tightly secure the cover to smooth pipe with reusable banding. The purpose of this outer cloth is to add an extra layer of protection from accidental hydraulic oil spray from nearby equipment. In case of an oil spray, this outer cloth could be removed, cleaned and then reinstalled.

IV EXECUTION – PIPING INTERNAL TO TEST CELL

A. The following lines will be insulated per the requirements given below:

1. 8" hot air supply and bypass piping to the compressor inbleed, includes the 10" bypass valve (HPA-FCV1-RK) and inbleed valve (HPA-QV1-RK).
2. 4" and 3" compressor out-bleed piping, includes the out-bleed control valve (HPA-FCV3-RK).
3. 3" and 2-1/2" 1-PAC hot air supply and exhaust piping to and from the test article on the test stand. This includes valves HPA-AV9-RK and HPA-FCV4-RK.
4. 3" 3-PAC hot air supply and exhaust piping to and from the test article on the test stand. This includes valves HPA-AV9-RK and HPA-FCV4-RK.

Insulation Requirements

- a. Where 2" thickness insulation is required as shown on the insulation sketches, install 2 layers (1-inch/1-inch thick) of ceramic-fiber on piping and piping components. Total insulation thickness will be 2-inches. Stagger joints between inner and outer layers of insulation.
- b. Where 1" thickness insulation is required as shown on the insulation sketches, install 1 layer of 1-inch thick ceramic-fiber on piping and piping components
- c. Use stainless steel wire to tie-down each layer.
- d. Install aluminum jacket (without paper backing) over all insulation. Lap aluminum jacket a minimum of 2-inches over the pre-insulated pipe supports.

- c. Install slip joints on the jacket to compensate for thermal expansion of the pipe. Expansion will be 1.4-inches in length for every 10 feet of pipe
- f. Install jacket in a water shedding position with a minimum 2 inch overlap on circumferential joints.
- g. Overlap all longitudinal joints a minimum of 2 inches and apply joint sealer to each face. Longitudinal joints will be positioned on the bottom of horizontal pipe.
- h. Apply joint sealer around all openings and cutouts and around all instrumentation protrusions through the jacket.
- i. Hot valves, flange pairs, and flexible metal hoses:
 - Install removable insulation covers on all hot valves and flanges. Covers to be fabricated with 2-inches of ceramic-fiber insulation with a stainless steel mesh inner liner and a silicon cloth exterior. Removable covers to be weather resistant and custom fitted to the location. Overlap on both sides to assure a tight fit-up. Fabricate covers to allow easy removal and reinstallation without damage to the cover. Position lacing on the bottom to help keep out water.
 - Provide weather resistant silicon cloth to be installed over the removable pads so that they extend past the pads and 6-inches onto smooth pipe. Tightly secure the cover to smooth pipe with reusable banding. The purpose of this outer cloth is to add an extra layer of protection from accidental hydraulic oil spray from nearby equipment. In case of an oil spray, this outer cloth could be removed, cleaned and then reinstalled.
 - On flexible metal hoses, **Do Not Insulate** the flexible portion of the hose. If required per the insulation sketches, insulate the end connections (butt-weld joint) to the same requirements as the joining pipe.